Written Testimony
Submitted to the
United States Senate
Committee on Energy and Natural Resources

On

Innovation in Action
Micro-grids and Hybrid Energy Systems
June 10, 2017

Respectfully Submitted By Meera Kohler
President and CEO
Alaska Village Electric Cooperative, Inc.

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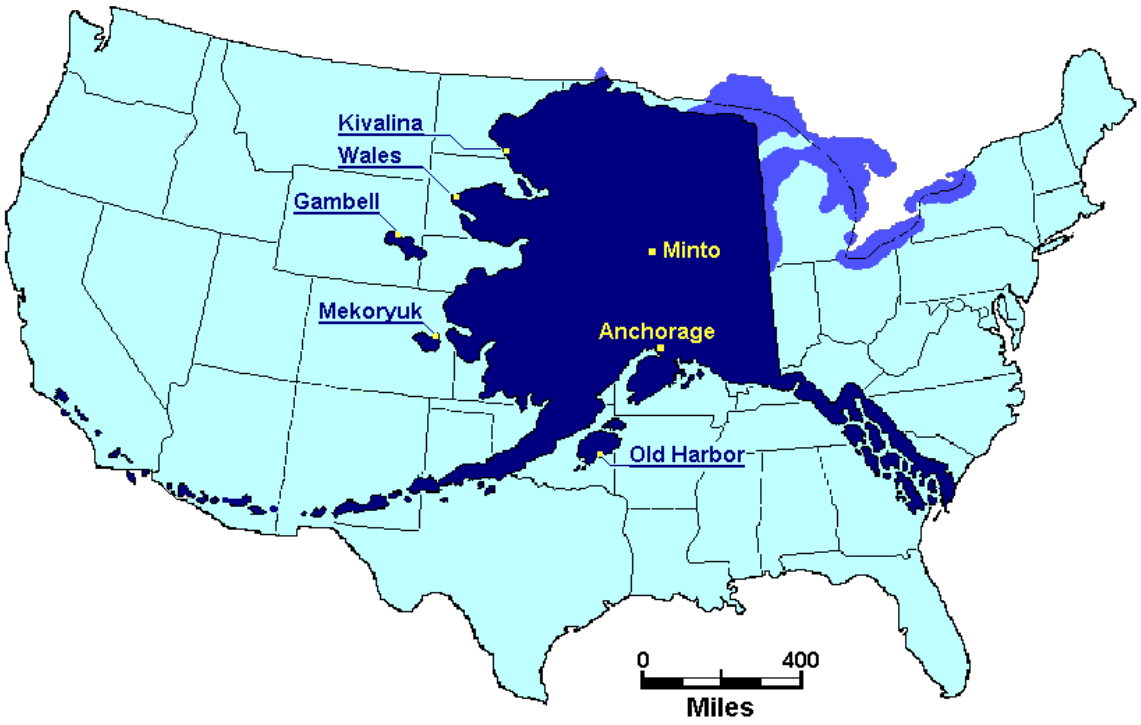
Chairman Murkowski, Ranking Member Cantwell, and Members of the Committee, thank you for the opportunity to testify on innovations occurring and sought in Alaska's micro-grids and hybrid energy systems.

My name is Meera Kohler. I am the President and CEO of Alaska Village Electric Cooperative (AVEC), a position that I have held since 2000. I started my career in the Alaska utility industry in Cordova in 1979 and greatly appreciate that this committee hearing is being conducted in what I will always regard as my Alaska home.

AVEC was established in 1967 as the culmination of an effort of the then-Governor of Alaska to find a way to deliver central station electricity to the small villages that housed Alaska's rural, mostly indigenous population. The task was daunting, given the distances, geography, absence of infrastructure of any kind and extreme climactic conditions of our great state.

Working with the Rural Electrification Administration, now Rural Utilities Service, a unique electric cooperative was established – one that would serve communities whose physical boundaries did not coincide with those of other member villages. This patchwork of electric grids began with three communities that were electrified in late1968. Old Harbor, Nulato and Hooper Bay are an average of 400 air miles from Anchorage, AVEC's base of operations and an average of 470 miles from each other. Our most recent community member, Yakutat, is more than 1,000 miles from Gambell, our western-most community.



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AVEC today serves 58 communities in Alaska and does so with 50 separate diesel fueled power plants. Several of our communities have populations of less than 100 while our largest, Bethel, has a population of more than 6,200.

Discounting Bethel, which is more than five times the population of our second largest community, the average village population is 450 – likely less than the occupants of a single apartment building in most cities.

To put the very small scale of AVEC's utility operations into perspective, a village's entire annual electric consumption is the equivalent of half the consumption of a grocery store in Anchorage. All 58 of our communities together represent a population of almost 33,000, about the same as Fairbanks, but the combined electrical usage is less than 1/10th of Fairbanks.

AVEC is, in effect, operating a series of 50 microgrids. These microgrids do not have the luxury of connecting or disconnecting to any other grid – as are virtually all communities and subsections of communities in the Lower-48. Instead we must provide redundancy within the community to allow for planned and unplanned generation maintenance. Extended outages in a community equate to life, health and safety crises almost immediately. During the winter, houses freeze up and human life is at risk. During the short summers, extended loss of refrigeration could mean the loss of an entire season of subsistence food.

AVEC systems typically consist of a stand-alone power plant with three or four generators. Sizing is carefully done so as to operate the most efficient generator to meet the needs of the day and the season. Redundancy is determined based upon having adequate capacity when the largest generator is down for maintenance and another fails unexpectedly. As a result, AVEC owns 85 megawatts of generation to supply an average load of 14 megawatts.

In addition to AVEC's 50 power plants, we maintain diesel tank farms in each community. Because fuel is delivered by barge during the short "open water" season, we must be able to store fuel for an entire year at a minimum. Since weather can delay the arrival of the first barge, we will generally ensure that we have up to 14 months of fuel on hand by the end of the delivery season.

In this day of the drive to distance ourselves from fossil fuels, rural Alaska's dependence on diesel is surprising to an outside observer. Alaska is one of the nation's leading energy states with vast reserves of natural gas. It would seem self-evident that Alaskans' energy needs would be met with inexpensive, low-emission sources such as that natural gas. That is not possible however, because Alaska lacks the basic infrastructure that is taken for granted in other states.

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Alaska has few roads, railways, adequate port and dock facilities, paved runways, transmission grids, communication grids and other elements deemed necessary for modern American society. As a result, we have had to develop micro-systems to meet the needs of the people who have been resident in these areas for many hundreds of years. These micro-systems come at very high cost per capita.

AVEC's investment in utility plant to serve our villages is more than $17,000 per service or meter. That is 4-5 times the investment typical in the Lower-48 and reflects the very large redundancy built into our generation system as well as the cost of the fuel storage systems that go with it.

Despite these staggering costs, AVEC has nonetheless been a leader in deploying wind generation in communities with a robust wind regime. We typically install wind turbines that, at peak output, exceed the connected electrical load at the time. We install diversion systems that deflect excess wind generation to passive loads such as water boilers in water treatment plants and other public buildings and reduce the use of diesel fuel in those facilities.

AVEC is unique among American cooperatives for having built and owning two tug and barge sets that deliver 90% of our villages' generation fuel needs.

AVEC has been deploying wind generation since 2003 and owns and operates the largest fleet of wind turbines in Alaska – 34 machines are located in 11 communities and serve another four through modest transmission connections. We are able to achieve 25%+ of our generation from wind in communities with optimal wind regimes. In 2016, more than 4% of the electricity we sold came from wind. In 2018 we will be installing additional wind turbines to increase our wind capacity by more than 50%.We also have a modest solar portfolio. We have developed innovative dispatch systems to maximize the value of intermittent wind generation.

We are committed to reducing our dependence on diesel fuel, which can only be achieved by improving efficiencies and by installing alternative sources of generation. In the last decade, connecting communities has been a priority and we have shut down power plants in five communities, thereby reducing emissions in those communities and improving the efficiency of the generators that serve them. Larger generators get better efficiencies and both interconnected communities benefit from an interconnection.

15 years ago, AVEC was appointed an energy partner of the recently established Denali Commission. The Commission was tasked with the mission of developing sustainable basic infrastructure in rural Alaska – a multi-billion dollar challenge. Energy infrastructure, the basic underpinning of modern society, was the overwhelming need. AVEC developed and pursued the "amalgamated" village approach – addressing all bulk fuel storage and generation needs in a community at the same time to take advantage of construction efficiencies from a single mobilization. As funding allows, power plants are upgraded with sophisticated control systems with intelligent dispatch

that are wind-ready. Smart meters are deployed through the entire AVEC system and virtual SCADA (Supervisory Control and Data Acquisition) systems are being developed.

AVEC has worked with engine vendors to develop machines particularly suited to Alaska's environment. We achieve higher efficiencies with smaller engines as a result. We are replacing conventional public lighting with LED lighting and have converted more than half our communities to LED.

15 of our communities are now served by wind hybrid microgrids. There will be 19 by 2019. We have displaced as much as 40% of diesel fuel in some of our most productive communities with highly innovative dispatch techniques. And we believe we can improve that by 10-15% with hybrid storage such as the Grid Bridge system that we have visualized and are pursuing.

We are working with innovators on emerging technologies – seeking answers to harnessing the forces of nature in wind, water and the earth. We hope to become a demonstration classroom for micro-nuclear generation, variable speed generators and other technologies that are on the edge of commercialization.

We believe Alaska can become a world-class leader in energy optimization by building a hybrid transmission system to replace liquid fuels with electricity generated by clean, super-efficient natural gas supplemented with wind and other renewables harnessed across Alaska. We can attract clean industries that appreciate our pristine landscapes and our inexpensive energy. We can nourish our people and our land through the wise and efficient use of our abundant natural resources.

It is time for a renewed, holistic approach to meeting the basic infrastructure needs of rural Alaska. The US chairmanship of the Arctic Council brought many leaders to Alaska and showed them our state through the eyes of our people. This is where the impacts of climate change are being most sharply felt. This is where economic and living conditions most closely resemble those of developing countries. This is where the vast resources of the Arctic Ocean nurture the land and the people and whose shores will witness the evolution of new transportation, tourism and mineral extraction activities.

I ask that as you consider a comprehensive energy bill, you also include revisions to USDOE's loan program that is currently geared toward "innovative non-commercial" technologies. It should be looking instead at deploying innovative commercially viable technologies, such as what we are trying to do on a small scale.

The federal government has passed legislation to help with the high costs of developing hybrid microgrids like AVEC's. In the 2007 Energy Independence and Security Act, Congress approved the creation of two matching programs to provide grants for up to 50% of the cost of installing proven renewable energy systems in high-cost regions. Unfortunately those grant programs have never been implemented by the Department

of Energy nor actually been funded by the executive and legislative branches. Providing funding for these programs, plus for additional transmission aid, also currently available through RUS, would dramatically improve the likelihood that islanded grids could afford to install renewable energy systems and not only reduce power costs over time, but also reduce the consumption of fossil fuels with their associated emissions.

We need the state and the federal government to work together to help Alaska take its place in leading the Arctic and the world. We need to renew support for the Denali Commission and the Rural Utilities Service, two of many agencies that play a pivotal role in rural infrastructure. We need you to partner with us on solutions for the future. We are the experts. We live every day striving to improve the lives of our remote Alaskan members. We know what can work and what cannot. All too often, we are told what it is that we need, by people who have never lived in rural Alaska, who have never actually operated a remote microgrid to understand the real issues and challenges we wrestle with and solve daily.

We should be expanding our vision of micro-grids to include sustainable clusters of communities that are not connected to a grid but that collectively can be served by robust technologies that represent reliable, affordable, clean abundant energy.

Thank you for the opportunity to testify.